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Gold on the North Saskatchewan River

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GOLD ON THE NORTH SASKATCHEWAN RIVER

By J. B. Tyrrell, Toronto, Ontario

For presentation at the Seventeenth Annual Meeting, Toronto, March, 1918

During the past half century the North Saskatchewan River has yielded more than half a million dollars worth of gold to the placer miners who have toiled with shovel and grizzly on its gravel bars, and who, in later years, with larger ambition, have used dredges to dig up more gravel from beneath greater depths of water than it was possible for men to dig with their shovels alone.

Physiography

The North Saskatchewan River rises in a number of rapid streams which are fed by glaciers and snowfields in the high interior ranges of the Rocky Mountains. Before issuing from the mountains many of these streams unite to form the main branch of the river, which then flows eastward and at about 150 miles from its source is joined by the Clearwater river near the site of the old fur-trading post of the Hudson's Bay Company, called Rocky Mountain House. Below the junction of the Clearwater it turns abruptly northward, and after keeping to this direction for forty or fifty miles again swings gradually eastward, which general direction it maintains past the towns of Edmonton, Battleford, Prince Albert, and Le Pas, until it empties into the great north-western expansion of Lake Winnipeg. Its total length in this distance is about 1,250 miles.

In the mountains its many branches flow in steep-sided mountain valleys. After leaving the mountains, the main stream cuts through the wooded ridges of the foot hills and then it flows across the great plains in a valley from 100 to 300 feet deep and a mile or more in width. Finally, 280 miles above its mouth, it leaves this valley and flows in a comparatively shallow channel through a low-lying forested country to Lake Winnipeg.

The general width of the stream in the vicinity of Edmonton is from 400 to 900 feet.

The volume of water varies greatly at different seasons of the year. In the autumn, winter and spring it is very low, but great floods come with the long hot days in summer, when the snow is melting rapidly in the mountains. At such times, when other prairie streams may be almost dry, I have known the water in the North Saskatchewan to rise twenty feet in twenty-four hours with a rush that would sweep away every obstruction in its course.

The average flow of the water in the river at Edmonton varies from 1,500 to 20,000 cubic feet per second, but in extreme high water it has been known to rise to 180,000 cubic feet per second.

HISTORY

When gold was discovered on the Fraser River in 1857, glowing accounts of the discovery quickly spread over the whole continent, and people began to rush to the new goldfields from all directions. In the spring of 1858 at least two parties of gold seekers started northward and westward from the State of Minnesota across the plains of the Saskatchewan to the new discoveries. One of these parties crossed the Rocky Mountains in October of the same year, while the other party only managed to reach Fort Pitt, a trading post of the Hudson's Bay Company on the Saskatchewan River above Battleford, where the men remained throughout the winter, and where in a quarrel one partner was shot in cold blood by one of the others. In the following spring these men continued on their way across the mountains to the Fraser River.

In 1859, parties of gold seekers continued to cross the Canadian plains on their way to the diggings on the Fraser River. One of these parties, of whom a record remains, consisted of Messrs. Colville, Reid, Dickman, Hind and two or three others, this party, having been met by the Earl of Southesk, near the Bow River, just as it was about to enter the mountains. Durin this year also, Dr. James Hector, afterwards Sir James Hector, was exploring on the Saskatchewan, and he states that somewhere in the vicinity of Edmonton "I have seen a few specimens of gold washed out."

In the fall of 1860, or in the spring of 1861, some American prospectors discovered gold, in what was considered to be paying quantities at the Rocky Mountain House, but whether these prospectors were going westward on their way to the Fraser River or to the newly discovered diggings at Caribou, or had come eastward across the mountains from British Columbia, is not certain.

In May 1863, when Lord Milton and Dr. Cheadle were at Edmonton, they speak of a party of miners coming in from White Mud Creek, about fifty miles farther up the Saskatchewan, where they had been washing gold. The leader of the band was a Kentuckian named Love, who had been in British Columbia searching for gold and had come eastward into what is now the Province of Alberta, through the Yellow Head Pass. He asserted that already that season the miners had recovered £90 apiece.

Another miner mentioned by Milton and Cheadle as being in the district at the time was Perry, who was well known on the Fraser River.

In 1866, reports of rich discoveries of gold on the Saskatchewan River spread among the miners on the Kootenay River, in the vicinity of Wild Horse Creek, and caused a stampede to Edmonton, but as the gold-bearing bars on the river were not found to be as rich as had been reported, the excitement soon died down.

For the next twenty years miners worked on the bars for about 75 miles up and down the river from Edmonton, with results which are said to have varied from one to twenty dollars a day per man.

In 1887, the first dredge was built on the river and from that time on to the present dredges have been working with varying success, though it is probable that most of the gold that has been extracted down to the present time has been taken out by miners working with shovel and grizzly as of old.

The following is a list of some of the references to the occurrence of gold in this river.

HECTOR, JAMES.—On the Geology of the Country between Lake Superior and the Pacific Ocean. Proc. Geol. Soc. (Lond.) Apl. 10, 1861, p. 405.

HECTOR, JAMES.—Edin. New Phil. Jour. Vol. 14, 1861, pp. 267-8.

MILTON, LORD AND CHEADLE, DR.—The Northwest Passage by Land. London, 1865, p. 187.

SELWYN, A. R. C.—Observations in the North-West Territory on a Journey, etc. Report of Progress Geol. Sur. Can., 1873-4, p. 58.

ELLS, R. W.—Report on the Boring Operations in the North-West Territory, Summer of 1875. Report of Prog. G.S.C. 1875-6, p. 289.

TYRRELL, J. B.—Report on a part of Northern Alberta. Ann. Rep. G.S.C. Vol. 2 (1886), Part E. Ottawa, 1887, pp. 12, 109, 134-5 and 151-2.

BANCROFT, H. H.—History of British Columbia. San Francisco, 1890, p. 525.

HOFFMANN, C.—Chemical Contributions. Ann. Rep. G.S.C., Vol. V. (1890-1), p.p. 66A and 65R.
Records the occurrence of platinum with the gold.

DAWSON, G. M.—Ann. Rep. G.S.C. Vol. VIII (1895), pp. 16-7A.

do Ann. Rep. G.S.C. Vol. XI (1898), pp. 11-19A.

McLEISH, JOHN.—Mineral Productions of Canada, 1912.
Ann. Rep. Dept. of Mines, Ottawa, 1914, p. 69.

OCCURRENCE

The gold occurs in very minute flakes and particles, associated with sand and gravel, from Rocky Mountain House all the way down to Prince Albert, a distance of 650 miles, but it occurs in greatest abundance on that portion of the stream beginning near Goose encampment, where the big coal seam at the top of the Edmonton series crosses the river down past Edmonton to the vicinity of Beaver Lake Creek, a total distance of about 130 miles. Throughout the whole of this distance the coal bearing Edmonton series forms the banks of the valley.

The gold, though in very minute flakes, is found associated with coarse gravel on such bars in the stream as are uncovered at low water. Many people consider that it should be found in the deepest parts of the river, where the bottom is usually

composed of soft mud, and one of the first dredging enterprises was started with the avowed intention of digging up the mud from these deep pools and recovering great quantities of gold, but the enterprise was a failure and those who were in charge of it were forced to learn that the heavy gold had been concentrated by the stream along with the coarser gravel, and that it must be looked for with this gravel and not with the fine and lighter mud.

Many people were also obsessed with the idea that they would find a pay-streak of coarse gold on bedrock, but the coarse gold was not present, and the conditions of the formation of the present river valley, the character of the bedrock, the fineness of the gold, and its perennial supply were all conditions which militated against the formation of a pay-streak on bedrock.[1]

Every year, in times of low water, men foregathered on the gravel bars beside the stream, washed the gravel in grizzlies and collected the gold on blankets, after which the blankets were washed and the gold was separated from the rest of the tailings by means of mercury.

At the present time gravel is being dug by dredges from the bed of the stream for use on the streets of Edmonton and for building purposes in the town. Before it is fit for use in cement it must be washed and it is now customary to wash it in sluice-boxes, and while freeing it from mud to recover any gold that may be associated with it. The gold so obtained is said in some cases to pay for a considerable portion of the expense of excavating the gravel.

A small amount of platinum is associated with the gold on the river, but up to the present time very little effort has been made to save it.

PRODUCTION

The returns of gold from the Saskatchewan River for twenty-six years, from 1887 to 1912, as given by the Department of Mines of Canada, are 14,684 fine ounces, of a value of $303,549.

As gold was discovered in workable quantities on the river in 1861, the time from 1861 to 1886 represents another and earlier

[1] See J. B. Tyrrell "Law of the Pay-streak." Trans. I.M.M. Vol. XXI, 1912., pp. 593-613.

period of twenty-six years, during which mining on the river bars was actively prosecuted, and during which these bars, being new and previously undepleted, were undoubtedly richer than they were during the succeeding period, so that it is reasonable to assume at least as large a production for the twenty-six years from 1861 to 1885 as from 1887 to 1912. On this assumption the river would have yielded, up to the end of 1912, gold to the value of $607,098.

In this connection, however, I would like to offer the suggestion that the Government of the Province of Alberta should appoint a Royal Commission to collect evidence from old miners and others as to the actual quantity of gold that was recovered on the river in early times, the positions of the bars that proved to be richest, and any other information that may now be stored away in the memories or note-books of some of the old men, but which will very soon be irrevocably lost.

GEOLOGY

The occurrence of gold on the North Saskatchewan is so intimately connected with the character of the rocks which underlie the country, the relationships of these rocks to each other, and their mode of origin, or in other words with the structural and historical geology of the country through which the river flows, that some idea of the progress of geological events in the Rocky Mountains and the country to the east of it is necessary before the extent and mode of occurrence of the gold can be clearly understood.

The Rocky Mountains, in which the Saskatchewan River takes its rise, consist of quartzites, sandstones, conglomerates, shales, and limestones, with many different local characteristics. They outcrop in attitudes varying all the way from horizontal to vertical and with a general strike in a north-west, south-east direction. All these rocks are detrital and consist of sediments which have been deposited in water. Igneous rocks, such as granites, diorites, etc., are almost entirely absent.

After the river issues from the Rocky Mountains its banks are composed chiefly of stratified sandstones and shales with occasional beds of coal. At first these beds are seen to dip at

high angles, but as the river is descended they gradually flatten out until they come to lie so nearly horizontal that the eye cannot detect the difference. In the vicinity of Rocky Mountain House the rocks are thick bedded brown sandstones, while lower down the river these are replaced by brown and white sandstones and sandy clays. The sandy clays prevail, especially for about fifty miles above and below Edmonton, when they in their turn gradually rise to the top of the bank and dark clay shales come up from beneath them and take their place. Thence down the stream to Cumberland Lake, these clay shales, known as the Pierre shales, are present in the banks of the valley.

On the terraces which are present on the sides of the valley east of the mountains, the sandstones and shales are overlain by beds of gravel of early glacial age, which have been called by Mr. McConnell, now the Director of the Geological Survey of Canada, the Saskatchewan Gravels.

Over the sandstones, shales and gravels is a mantle of boulder clay which, in descending the river, is first met with some little distance below Rocky Mountain House as a thin sheet of unassorted clay, or merely as a few erratics scattered over the surface. The sheet of clay becomes gradually thicker as the river is descended, until in its lower portion from Prince Albert downwards, the banks are composed largely of it. This sheet of stoney clay is found on examination to consist of materials derived from the underlying shales and sandstones mixed with boulders and some fine rock flour brought from the Archean peneplain to the north and north-east. These materials have all been kneaded together by the great ice sheets of the Glacial period into one homogeneous, unstratified, stony mass.

In addition to the beds above enumerated, gravel, sand, and mud of recent age occur in the bottom of the stream and on the the low alluvial flats which bound it on one or both sides.

It is from these sands and gravels that the gold has been chiefly recovered, but a certain quantity of gold has also been recovered from the Saskatchewan gravels which lie on the terraces above the level of the river.

The rocks, sands, and gravels which have just been enumerated have been formed under conditions which may be briefly outlined as follows:

In early Pre-Cambrian times a land area, formed of gneiss schist, etc., existed in that portion of British Columbia which lies west of Canoe River and thence southward to the Arrow Lakes, where the gold range at present stands. To the east and west of this land area was an Oceanic Depression, but the western depression does not concern us here, so we will confine ourselves to the consideration of the eastern one, and in order to clarify our ideas and to keep clearly in mind the particular body of water in which the rocks above enumerated were deposited, we will call this eastern Oceanic Depression the *Albertan Sea*.

Throughout the whole of Paleozoic times sand and clay were carried from the land area on the west into this Albertan Sea, and beds of limestone were also formed in it. As the beds of sandstone, shale and limestone gradually became thicker and thicker the floor of the Sea continued to subside, until at the close of the Paleozoic era an immense body of stratified deposits, nearly nine miles in thickness, had accumulated on the Ocean floor along the line now occupied by the Rocky Mountains.

About the beginning of the Mesozoic era the western portion of the area occupied by this great thickness of stratified deposits rose above the level of the ocean, but nevertheless the Albertan Sea, though greatly narrowed by the elevation of its western shore, continued to exist, and drainage channels doubtless continued to flow into it from the Old Gold Range to the west across the newly risen country. Since the rising of this land was doubtless gradual, Mesozoic deposits were laid down near the western shore of the Albertan Sea conformably on the older Paleozoic sandstones, limestones, etc., to the west of them.

This deposition of sediments in the Albertan Sea continued with comparatively little interruption throughout Mesozoic times. About the beginning of the Cretaceous epoch, however, warping and folding began in the Rocky Mountain belt, while the Albertan Sea became gradually enlarged through the sinking of the country to the east, until by Middle Cretaceous times it had reached eastward as far at least as the present Lake Winnipeg, and from that time onward until the close of the Cretaceous Epoch extensive beds of shales and sandstones were deposited on the

floor of this new portion of the sea. Also, until the end of Cretaceous times the main drainage channels of the western country appear to have continued to flow eastward across the gradually rising land to the west of it, carrying the drainage from the sources of these streams down into the Albertan Sea. Some of these streams doubtless flowed from tracts of the country which were rich in gold, while other streams flowed over country which did not contain gold.

Towards the close of the Cretaceous epoch the Albertan Sea gradually began to be cut off from the main ocean and to become shallow, so that the sandstones and clays which were deposited during the terminal period of the Cretaceous, which is known as the Edmonton period, were deposited in shallow brackish water, with the formation of great beds of coal along the coast line of this dwindling sea. During this Edmonton period the streams from the west still took their rise in the mountains of the Gold Range, although they flowed across a belt of land from 100 to 200 miles in width before they discharged their load of sand, accompanied by a little fine gold, into the Albertan Sea.

At the close of Cretaceous times the Laremide revolution set in, when the rocks of the Rocky Mountain belt became intensely folded and great faults developed, along which the older rocks were shoved up and pressed over the newer ones for distances which were sometimes as great as six or seven miles. This mighty revolution and upheaval, during which the Rocky Mountain belt suffered a contraction of about one-half its original width, cut off the drainage which had flowed across it, and from that time onwards the summit range of the Rocky Mountains formed the water shed for the eastern drainage, which for a time continued to flow into the diminished representative of the Albertan Sea, now separated from the ocean and occupied entirely by fresh water. In this great fresh water lake the sandstones, etc., of the Pascapoo or Lower Eocene series were deposited.

During the remainder of the Tertiary epoch the mountains and plains through which the North Saskatchewan flows were suffering active erosion, and in places many hundreds, or even

thousands, of feet of the surface were removed by atmospheric and stream erosion and carried away to the ocean

At the close of the Tertiary era the Glacial period began At first glaciers formed on the Rocky Mountains and moved eastward down the main valleys and out towards the plains, while from the faces of these glaciers streams loaded with gravel rushed on down the valleys, and, depositing their loads, formed the Saskatchewan gravels.

At a later time ice sheets developed on what is known as the Keewatin Glacial Centre, far to the north-east on the Archean peneplain, and from that centre extended over the whole country southward and south-westward to within a short distance of the base of the Rocky Mountains, carrying with them material from the Archean and Paleozoic rocks over which they moved, and leaving on their retirement a great sheet of stoney clay or boulder clay spread over the surface. In places, especially on the eastern parts of the plains, the glaciers filled up the old Pre-Glacial valleys with this stony clay, while in other places, as in the country about the upper parts of the North Saskatchewan River, they dipped into the valleys and merely deposited a thin layer of stony clay in these valleys over the surface of the sandstones, shales, and Saskatchewan gravel.

When the Keewatin glaciers had retired, the North Saskatchewan River, like most of the other rivers flowing from the mountains, resumed its old course. In those portions of its valley which had not been reached by the Keewatin glaciers, or in which the Keewatin glaciers had deposited but little stony clay, it continued to deepen and widen its valley as before, and where, farther east, the glaciers has almost blocked its valley with a heavy deposit of clay, it had re-excavated its channel so that it is now everywhere flowing on a bed of the underlying rock.

On this bed of rock, which being shale or clayey sandstone has usually a smooth or slippery surface, recent gravel, sand and mud have been deposited, except on those places where the river is at the time actively engaged in deepening its channel, and with the coarser of these sediments the gold which is being fed into the river from time to time is concentrated.

SOURCE OF THE GOLD

During the early days of mining in the river, many years of time and many thousands of dollars of money were spent in searching in the mountains and on all the upper branches of the river for the lodes from which the gold was supposed to have been derived, but without favourable result.

As early as 1861 Dr. Hector, commenting on the reported discovery of gold in the Saskatchewan, states, "There is no trace on that side of the axis (of the Rocky Mountains) of the ancient rocks from which it must have been derived," but he has no suggestion to offer as to whence it was derived.

When Dr. A. R. C. Selwyn, then Director of the Geological Survey of Canada, descended the river in 1873, he recognized that the gold was not derived from the mountains at the source of the river, and that the search for coarse gold and 'mother lodes' in that direction was hopeless. As a forlorn hope he suggested that it was washed out of the boulder clay which had been transported across the great plains from the Archean peneplain far to the north-east. The problems of glacial transportation were not then understood as they are now, and the drift was supposed to have been transported by water and icebergs, whereas we now know that it was carried by ice moving over the land.

At the present time no one would think of urging that the gold in the Saskatchewan and the other streams flowing from the mountains was derived from the till or boulder clay, knowing that the upper portions of these streams, flowing through parts of the country which had been near the border of the ice-sheet, where the quantity of till derived from the Archean peneplain was very small, were rich in gold, while the lower portions of those same streams, flowing through thick beds of till nearer the source of supply, and consequently richer in such heavy metals as gold, contained no gold. If there had been gold in the boulder-clay it would have been more abundant in it near the source of supply, and where the streams in their lower portions flowed through thick beds of this boulder-clay they would certainly, in case the gold had been derived from the boul-

der-clay, have been much richer in gold than in those portions which lay around the extreme edge of the ice-sheet.

If the gold on the Saskatchewan River had been derived from the boulder-clay which occurs in decreasing quantity on its banks as the stream is ascended, the ice sheet of the Glacial period, by means of which this sheet of boulder-clay was carried to its present position, must have carried all the gold-bearing portion of this boulder-clay over the north-eastern parts of the Great Plains without dropping it, while it dropped most of the rest of its load, even though composed of lighter material, until finally, when it reached its farthest western extension, it sprinkled its load of gold over the country near the foot of the Rocky Mountains.

Such a reversal of ordinary natural laws did not constitute a satisfactory explanation of the source of the gold, so that some other explanation had to be looked for.

In the year 1886, while investigating the geological features of the country along the Saskatchewan river for the Geological Survey of Canada, an old prospector named Haney drew my attention to the fact that gold occurred in what he considered to be a volcanic 'blowout' on the north bank of the river, which 'blowout' proved to be the clinkers and cinders left from the natural burning of the Big Coal Seam over a considerable area. Haney's assays of the cinders yielded small quantities of gold, and the assays of my own samples, not only of the ashes and cinders of the coal, but of the adjoining rock, shewed traces of gold.[2]

A somewhat similar occurrence of gold in association with coal of Cretaceous age, though slightly older than that on the Saskatchewan, has recently been recorded by R. W. Stone, of the United States Geological Survey, from the Cambria Mine in the State of Wyoming.[3]

E. T. Dumble has also recorded the occurrence of gold in lignitic sandstone in the lower Eocene of Texas.[4]

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[2]Report on a part of Northern Alberta, by J. B. Tyrrell. Ann. Rep. G.S.C. 1886. Part E., p. 109.

[3]R. W. Stone. Coal near the Black Hills. Bull. 499. U.S.G.S. 1912. pp. 63-4.

[4]E. T. Dumble. The Occurrence of Gold in the Eocene Deposits of Texas. Trans. A.I.M.E. Vol. 44, 1912., pp. 588-591.

This discovery of gold in association with a bed of coal at the top of the Edmonton series of the Cretaceous provided a clue to a rational explanation of the origin of the gold on the river.

Fuller investigation showed that that portion of the river in which the gold was most abundant was underlain by the coal-bearing rocks of the Edmonton series which were deposited in their present position just before the Laremide revolution raised the Rocky Mountains to their present altitude and grandeur, and that after a particularly heavy flood had swept down the river, and had washed down and re-assorted heavy slides of the soft Edmonton rocks, the bars would be enriched with a new supply of gold. It was also recognized that the rocks of the Edmonton series were not such as might have been derived from the degradation of the quartzite, slates and limestones of the Rocky Mountains, but that the material of which the sandstones especially were composed, "was such as might be expected to be derived from the degradation of granitoid rocks." On this evidence the theory was advanced that the fine gold in the river was derived directly from the Cretaceous (Edmonton) rocks which formed the banks of the stream, and that these rocks in their turn were an old and very low grade placer deposit which had come originally from the mountains west of the Upper Columbia valley.[5]

After the publication of the report of my investigations in 1887 useless and expensive search for the source of the gold in the mountains almost entirely ceased, and the attention of the miners was devoted to the exploration of the bars within the productive area marked by the outcrops of the rocks of the Edmonton series, so that while in 1887 the production had fallen to $2,100.00, in 1896 it had again risen to $55,000.00.

It has been shown that the rock at the summit of the Edmonton series, associated with the Big Coal Seam, contains gold in small but appreciable quantities, but it has not yet been shown whether there is some band of clay or sandstone in this series which is decidedly richer than the others. It is just pos-

[5] J. B. Tyrrell. Report on Northern Alberta. Ann. Rep. G.S.C. 1886, Part E, pp. 134-5 and 151-2.

sible that such a bed might be discovered which would be rich enough to pay for working, or failing this a bed might be discovered and identified which could be assisted to fall into the river, to be there assorted and concentrated, with the purpose of quickly enriching the bars for the miners.

The supply of gold to be obtained from the sandstones which form the banks of the Saskatchewan valley is unlimited, but nature is drawing on this supply very slowly. It is quite possible, however, that nature could be easily assisted in procuring the gold from these sandstones to the great benefit of the mining industry of the Province of Alberta

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